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HINTS

—ON—

BUILDING.

—BY—

J. H. CARPENTER,

ARCHITECT AND CONSTRUCTING ENGINEER,

HARTFORD, CONN.

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118 ASYLUM ST., HARTFORD, CONN.

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CONTENTS.

INTRODUCTORY.

The subject of house building is of interest to all, even though they may not be in a condition, financially, at the present time to build. A few months or years may, however, so materially change the aspect of affairs as to render it possible. It is therefore well for all to anticipate the realization of a *home of our own*, and become familiar with the requisites of a good house; it is certainly worth all the trouble taken to acquire it.

The object of this treatise is to present only the most important facts about the practical work of building, to aid in securing the highest order of beauty in the art and workmanship, which shows cultured taste in a common-sense course of construction; and to prevent, if possible, the crowded effusions of ornament, and show that the most humble attempts are worthy of study and adaptation to laws of harmony and order.

After considering briefly the preliminaries of building, the practical details will be considered in a general way, as *hints* in divisions of labor, and trade work, and in sub-divisions. so clearly marked that they can be readily applied where the class of work described is only to be partially used in building.

Technicalities are avoided or explained that the hints may be understood by the non-professional as well as experts in the business.

In explanations of methods of practice we do not define them as the *only* way, for in our experience we have found methods more or less opposed to these to accomplish equal results, by careful manipulation, but the rules given are those most generally used in several different sections of the country and have not failed to give satisfaction.

As a rule, explanations of method are not given, because they are not necessary to the owner to assist him in judging of the work; but it is enjoined upon him to see that materials used are of proper qualities and well worked, if he would have permanent results and satisfactory finish.

These hints about labor and quantities will enable any one with a little study to make approximate estimates of cost by charging to the labor the wages paid them, and for materials the local prices. It would be impossible, without injustice to the trades, to state prices, as they fluctuate; but it will always be within the reach of those desiring prices to obtain them of any person in that business.

"VISTO, HAVE A TASTE."

For what has Virro painted, built, and planted?
Only to show how many tastes he wanted.
What brought Sir Visto's ill-got wealth to waste?
Some demon whispered, "Visto! have a taste."
Heav'n visits with a taste the wealthy fool,
And needs no rod but Ripley with a rule.
See! sportive fate, to punish awkward pride,
Bids Bubo build, and sends him such a guide,
A standing sermon at each year's expense,
That never coxcomb reach munificence!

You show us Rome was glorious, not profuse,
And pompous buildings once were things of use.
Yet shall (my lord) your just, your noble rules
Fill half the land with imitating fools;
Who random drawings from your sheets shall take,
And of one beauty many blunders make:
Load some vain church with old theatric state;
Turn arcs of triumph to a garden gate;
Reverse your ornaments, and hang them all
On some patch'd dog-hole ek'd with ends of wall:
Then clap four slices of pilaster on't,
Then, lac'd with bits of rustic, makes a front.
Shall call the wind thro' long arcades to roar,
Proud to catch cold at a Venetian door;
Conscious they act a true Palladian part;
And if they starve, they starve by rules of art.
Oft have you hinted to your brother Peer
A certain truth, which many buy too dear;
Something there is more needful than expense,
And something previous ev'n to taste—'tis sense;
Good sense, which only is the gift of heav'n,
And tho' no science, fairly worth the seven:
A light, which in yourself you must perceive:
Jones and Le Nôtre have it not to give.

To build, to plant, whatever you intend,
To rear the column, or the arch to bend,
To swell the terras, or to sink the grot,
In all, let nature never be forgot;
But treat the goddess like a modest fair,
Nor overdress, nor leave her wholly bare;
Let not each beauty ev'rywhere be spy'd
Where half the skill is decently to hide.
He gains all points who pleasingly confounds,
Surprises, varies, and conceals the bounds.

—*Epistle IV, Pope.*

HINTS ON BUILDING.

SKETCHES.

To begin properly every person contemplating building should commence to *plan on paper*, no matter how crudely, their ideas of their requirements in the kind of building wanted, figuring the sizes, and making memorandums of anything thought necessary for special use or finish in each room.

You know your own necessities better than another can tell you, and it is not the duty of an architect to invent necessities for you, but to gather up the threads of your wants and embody them in construction, detail, and finish as an expert. It is a mistake to adapt your wants to a pre-arranged design;—get the requisites of plan in order first, and it is the evidence of being a good architect for one to draw these requisites into the harmony of a good structure.

All alterations of arrangement should be made in the sketches. The greatest mistake, as many have found to their cost, is to make alterations while the building is being erected.

These sketches, when completed, are of the greatest value in determining the working plans and designs. They are not expected to give accurate ideas of construction or finish, therefore persons often feel their inability to make them, because from them they are not able to realize how the buildings will look when completed.

As this is particularly the architect's work, we feel it a pleasure to offer our assistance in making perspective sketches, which will show the appearance of the structure when completed, and offer also such advice in consultation in adapting your ideas in the sketches to your wants and the situation as may be necessary.

After the sketches are all satisfactory, all alterations made and your wants provided for, it is then time to make plans and working drawings, and not before.

PLANNING.

Having determined to plan a house, and commenced sketching, it is necessary not only to consider the rooms we want as mentioned in article

on sketches, but to consider the portion of the house as to sunlight, that all the rooms, if possible, shall obtain it. Next as to airy breezes, and placing the openings so as to get all that may be beneficial, not only of clear, cool air from northern exposures, but also, and more particularly, the balmy breezes of the south. Of course this is not always possible on a city lot locked in between great masses of buildings, but these points must be kept in view when planning, as far as they apply.

The views of landscape in some situations are also an important consideration to be looked after, and advantages of views should be given to as many rooms as possible.

Comfort, convenience, and pleasure must each be considered, and though we know considerable twisting about of rooms is necessary to accomplish it, yet with these principles before us we do not see why an owner cannot arrange a plan to suit himself without copying after some other house which does not exactly suit. We advise the consideration of other people's successes in building and obtaining comforts, but would have you avoid their errors in ignoring these rules when they started.

And to aid in solving this problem we will consider the requisites of a few rooms, leaving the rest required to be put in in the order in which they may suggest themselves. And if in our theory we seem to any to avoid the more humble cottage, we would say, as far as a person's means will permit, the principles apply completely, and yet suggest more extensive outlay to those who can afford it.

HALLS.

If the first impression on entering one's home is pleasant, the sensation of pleasure will follow one through the entire house; if to the contrary, a much greater amount of enjoyment must follow to counteract that effect. Apply this truth to the *hall*, and its force is seen at once.

An oblong passage without architectural beauty, cold and cheerless, without any furniture excepting a rack and a chair, makes one hurry through without a feeling of welcome or rest; while a furnished hall, as a part of the house, properly heated, and with such additions as will make it inviting, will prove a much greater addition to our enjoyment than we think.

Our idea of a hall is as a rotunda, giving access to each apartment and seemingly a part of them; stairways subservient to it, and not the principal feature, except the reception and other rooms be on the second story, which is not very common in this section of the country.

A hall may rightly become the social center of the house, and for

hundreds of years held its position as such in old castles and homesteads. It is by far the most economical and convenient arrangement to have it so. It may be two stories in height, or even extend to the roof, and have balustrades to each story. The addition of a fire-place, where it can be added, completes the picture of comfort.

DINING-ROOM.

This room, if arranged conveniently, with easy access to butler's pantry, with china closets, dressers, etc., fitted in it, is the *mater familias'* paradise. It should be well shut off from the kitchen, and kitchen servants should not have access to it except by way of the pantries, through appropriate openings. It should always have an open fire-place, for use in weather when heaters are not in use, and also in connection with them to add cheerfulness.

A conservatory adjoining would be an abundant source of supply of those additions which attract the mind from things of ordinary life. The furnishing and decoration should be quiet, light, and suggestive. Other things can be said, but as more abundant means suggest one's own enjoyment, we will confine the remarks to homes of the majority.

In the arrangement of rooms it is always best to place a dining-room east and west, that it may have the morning and evening light, and be cool, without the glare and heat of the day. In most houses it cannot be set so as to have both, but if either can be obtained, the morning light is preferable.

KITCHEN.

Suggestive to the *pater familias* of enjoyments which cater to the greater number of senses by a large majority, but a domain which a man usually hates to enter.

Our idea is that a kitchen is not usually all it should be, when we consider of what importance it is to the household, and that few of the beauties of art in building or decoration are ever introduced into it. Owners should provide more liberal expenditures in this part of the house, which is sure to pay good interest. It is well to commence with the motto, "A place for everything, and everything in its place,"—and provide the places.

A kitchen, to begin with, should be well lighted and well aired by large windows opening on every side possible. The ceiling should not be low, and ventilation should also be secured by way of the chimney, that savory smells may be drawn off and not left to spread through the house.

The range and fire-place should be as perfect, and large hearths in front of them. Shelves over them should be avoided as a catch-all, which collect dust, to some future annoyance, but hooks should be in handy places; shelves should be provided, but in other appropriate places. *Dressers*, enclosed with glass doors, fitted with drawers, cutting-boards, suitable shelving, and nests of boxes. Sinks should be large and deep, with drip-trays at side, and separate sinks provided for dish-washing in or near the buttery, all connected with hot and cold water.

Wastes to garbage-boxes should be arranged, admitting of immediate and ready use, that all refuse may be thrown out as it accumulates, and that food will not appear as a garnished exodus from an assortment of peels and rubbish.

The floors should not be cold, and thereby injurious to health. If made of wood, they should be double, for warmth; if covered, there is material made, of any desired width, which will cover a floor without seams.

The exposed walls should be wainscoted to the height of chair-backs, and decorative dadoes can be formed of oil-cloths of appropriate pattern; other walls painted in cool neutral tints.

If the arrangements of building do not admit of a separate laundry, then let the tubs be arranged with covers, to form tables. Soapstone is preferable to wood, for many reasons.

Laundrys should, if possible, be a separate arrangement, with hot and cold water appliances, and separate stoves for heating irons, etc., and should be well lighted and airy.

All boxing in of tubs, boilers, and sinks should be avoided as far as possible, and much trouble with vermin will thus be prevented. Also see to it that the plastering extends to floors behind all closets, surbases, etc., and that nooks for vermin be effectually closed up when building.

BATH-ROOM.

A bath-room is a necessity, and all suites of rooms should be provided with them, complete in every detail and attractive. It is so common to put them off in some out-of-the-way corner that it is often a puzzle to find them. As usually constructed they are a nuisance, and distance lends enchantment. But that they should be so constructed is all wrong: convenience is the first consideration; plenty of sunlight, air, and ventilating appliances the next.

Complex plumbing apparatus is not necessary, nor special patented conveniences, in order to secure comfort, but the cheapest as well as the

more expensive can be rendered of service, free from obnoxious associations, and desirable, if more attention were given to the proper understanding of them by owners. And an architect who fails to impress on his client the proper necessities, and provide them, does him a grievous injury.

FORM OF BUILDINGS.

The form of buildings results from their internal arrangement of rooms; the design is subject to nearly all the styles of architecture. Some forms of structure look better finished in some styles than in others; and the form often suggests the style.

A square-built house has many attractions to some because of the conventional simplicity and square effect of every room, and the large, roomy halls and stairways; but it is far from attracting others by its external appearance in comparison with the irregular-shaped dwellings, which add those pleasant surprises in form, filling up blanks, hiding shady nooks, tempting investigation and presenting attractive approaches. Pleasing views are also obtained from rooms which are cut off. Sunlight and breezes find windows to enter by, and pleasing effects of designs show to the best advantage.

The difference in cost in relative style and finish when completed is so small that the majority prefer to pay it; and the difference in appearance counterbalances the actual cost by a large percentage.

DESIGN OF BUILDINGS.

The design of a building in many respects represents the character of the projector. It is surprising how the designer intuitively incorporates the characteristics of another into the design, utterly forgetful of himself, and the owner wonders how it was so wonderfully like his ideal, as it grows under another's hand, while the whole art and study of the designer is to obtain that very result—to study those peculiarities of the owner's ideal; and that the more it is adapted to his character the more likely is it to prove a source of pleasure to him as an occupant;—keeping in view also the other points which govern the design:

1st. The legitimate influence of materials must be considered, and based, as a rule, on a knowledge of style and precedents. It is useless to ignore the fact of their influence. We may try to conceal or counterfeit material as we like, the logic of fitness confutes us; the results betray the deceptions.

2d. The relation of purpose and arrangement to design; for a building is faulty in design which fails to show its use.

3d. The structural conditions, truthfully shown, form a basis for the architect's highest ingenuity. There are pleasing effects in any building which shows its ability to sustain itself to its use. And, as is too often the case, the construction should not be concealed nor false systems of support used just for the sake of giving the appearance of strength. A little crack in the joints is a fatal mark against it, and has the unhappy faculty of appearing much larger than it is.

4th. The relation of ornamentation to construction has greater claims upon us than most designers are willing to give, because it prevents the use of flattering pieces of work which true taste at once prohibits. The only true theory is to ornament construction; after that is done all other ornamentation must be subservient, or it will prove to be a blemish. Over-dressing shows a weakness of character: nobility in art is the highest aim. The ancient temples a lover of classics and art will ponder over and view in awe, observing the grand effects of construction, so simple and so true; and as soon as the eye begins to examine the details of construction it is entranced with the wonders of the ornamentation which seem to open up in every direction,—in no way obtrusive, entirely subservient to the construction; and surely their examples of the true theory of ornamentation are worthy of our following.

INTERIOR DECORATION

Is gradually gaining popularity, and examples of taste and refinement are now to be found in the houses of those in moderate circumstances as well as in those of the wealthy.

The methods of uneducated decorators are now being replaced with studied designs, which show elegence in taste and adaptation to their uses and situation.

Judicious decoration in oil painting, distemper, fresco, water-glass, etc., all have their place, but should not be brought too prominently forward in place of the more elegant achievements in relief decoration now becoming more extensively used and within the reach of even quite limited purses. The genius of invention has provided resources, besides the hand processes of carving, which, used in combination, produce those happy results of which the owners of ancestral halls are so justly proud.

Nothing less than stern necessity should compel an architect to forego in interiors the infinitely various and charming effects produced by light glancing on raised, rounded, and re-entering surfaces in addition to the ordinary methods of pleasing the eye by colors and lines.

It is usual for owners to plan the building without regard to future

decorations, trusting to happy circumstances to suggest the style and finish, after all the wood-work, etc., is in place; but it would be far better to have the designs of the interior made at the beginning, that the wood-work may be gotten ready for future additions, and harmonized with them. Every house should be rendered artistic and harmonious in its decoration and furnishing.

If the art work of our homes is treated as a separate thing and left to chance conceptions, it will be all false, having no realistic life, and quite likely to result in a mongrel worthy of being consigned to oblivion with the conceited so-called esthetes.

The selection of goods should be in true taste and color, and to suit, and not because they are an exact copy of some one else's. If not found in stock in the market, direct appeal to a manufacturer should be made and followed up until the goods are supplied, it being well to remember manufacturers are glad of opportunities to suit enquirers, without adding additional cost to the production over the price of other goods of the same quality. Let the enquirer also be consistent, make careful preparation of designs, and then maintain them, even against pretty things, which are apt to be only a temptation to be afterwards regretted.

It is not necessary because a design is elaborated that it should be more expensive, but a reason why it should be less, and a surety that value is received for value given. So many cheaper goods are now in market ready for use which will give fine effects, that we advise all parties to give decoration serious consideration, and when it is possible to obtain them, to do so.

The finishing coat of plastering can be tinted in colors before it is applied, making a soft, beautiful finish and not subject to peeling off as oil paint improperly applied. It is not necessary to follow the conventional white walls; tinted walls are quite as handsome, applied this way, as expensive painted ones. It can also be mixed with glue, so as to be already sized, and will take the oil colors more evenly, and often save an extra coat of color, besides making a harder and polished surface. If it is designed to be papered, some expense in plastering can be saved by using a cheaper finish well adapted for it.

It is very desirable that owners should give their architect more liberty of design, and be more willing to allow them some liberty in design and cost. We are always more ready to make additional designs to reduce expense than to attempt to remodel a costly one. If designs cannot be produced complete at prices to suit, according to your ideas, it is better at once to decide to pay the cost and complete it

or else abandon it, and try another design less costly to finish. A good design half completed and without its proper finish is a blemish and easily detected by an artistic eye.

PLANS AND SPECIFICATIONS.

It is a great mistake to attempt to put up a building without complete plans, specifications, and working drawings, having complete technical and legal descriptions of labor and the materials to be used.

Carefully studied construction drawings enable the builder to calculate accurately the amount and sizes of material, and the labor required, saving all waste.

The *cost* of plans and specifications is comparatively a trifling percentage of their value, and is in proportion always to the amount to be expended in building. In numerous ways several times their cost is saved, and a better structure is secured in design and workmanship.

Written agreements are a proper and necessary accompaniment to the specifications, and a part of them, whether the work be contracted at a stipulated price or by day's work. Let no man foolishly suppose, for a moment, that a verbal agreement is of any value as a building contract.

All parts of the work as well as prices should be stipulated, the manner of making payments, insurance clauses, method of arbitration agreed upon, etc., in a legally written paper, setting forth also that all work of addition or alteration shall be in writing and a part of the agreement; that the work shall be in full, fair compliance with the terms of the plans and specifications and subject to the approval of a superintendent, whose authority shall not be a matter of dispute. A proper agreement waives suspicions, settles numerous disputes, and becomes a matter of pleasure between the contracting parties.

THE ARCHITECT AND ENGINEER.

In every true architect there are, as it were, two individuals: the *artist*, who by his imaginative genius conceives and combines solids and voids in harmonies of design, his mind grasping in advance of execution all the effects, and detecting in his study all surroundings that will add to or detract from its beauty or utility, thus bringing out the building to its best advantages; and the *constructing engineer*, who must understand all the requisites of proper and substantial construction, from theories established upon his own experience and that of other masters, be personally familiar with strength of materials, their weight and resistance to direct and transverse strains; must arrange them also to accomplish their

purpose without waste of substance, and yet in such uniformity with his conceived design as to be a part of it.

Before science subjects him to the rigor of mathematical calculations, his artistic genius rises to conceptions which feeling alone should judge; and as a constructor he makes those conceptions a reality in form and power.

He must be familiar with the technical requisites of all the trades and manufacture connected with building, and a judge of all work done from that of the humblest mechanic in the drains to the high art of the esthetic decorator, and the finishers of all that is to add beauty in finish.

Much more can be said, and is said, which but faintly outlines the diversity of accomplishments he must in mind, body, and soul be in harmony with, besides the practical every-day work of the mechanic.

He must not only plan, design, and arrange the work in detail, but give it his practical and personal supervision until completed, and draw the minds of all men engaged in the execution of it into harmony with his conceptions that they may assist him in completing them.

The high price of materials and labor has necessitated more thorough study of engineering than was required of architects in past times; then it was sufficient for him to simply design and direct its fulfillment, materials being abundant and labor low-priced. This being much more congenial, leads many to forget the more irksome study of the abstruse theories of construction; but now the owners are not satisfied, and should not be, until assured to a mathematical certainty that their works are sufficient in strength and durability.

The most satisfactory results in building are obtained also when an owner consults his architect in perfect confidence, even against the most decided objections and the wishes of others, who, if they have no personal motive, are too often riding hobbies. If innovations or changes are necessary, the merits of the case are quite assured of proper consideration in a good designer's hand, for such an one is not arbitrarily wedded to any hobbies of his own, but will at all times seek to combine the wishes of the owner into harmony with the structure.

A contractor understanding his business will seldom work adversely to the architect, but find it a pleasure to work with him in securing the best practical results.

The charge is sometimes unjustly made against architects of receiving commissions or bribes from builders on account of work done under them. That such is the case in some instances is well known, and all architects having the success of their business in view, sincerely regret that it is done.

hold it in abhorrance, and stand ready socially and professionally to ostracise any architect accepting it, or a builder offering it. The high dignity and honor of their profession is conscientiously maintained by such to their credit, even when sometimes poorly compensated for their labor by the owners.

It being justly and properly assumed that those who offer a commission are of a character not to be trusted to carry out a contract, and, as the sequel shows, are ever ready, when a bribe fails, to destroy the confidence of the owner in his architect, fearing also to meet an honest supervision of their contracts and most ready to take advantage of an owner's confidence in them, we therefore strongly advise all owners that, having the plans and specifications once adopted and work begun, they consider no changes whatever except in the presence of the architect. This procedure will ensure safety against extortion and allow an open investigation of all the necessities of the case.

ECONOMY IN BUILDING.

The aggregate expense of building in proportion to results has usually been so enormous that many persons are discouraged from attempting it.

The large startling items and the possibility of innumerable bills of extras coming afterwards show the necessity for deliberate action in getting ready before the job is undertaken.

With some there is a tendency to over-estimate the capacity of money in building, and they are apt to build beyond their means, and put in many things recommended by friends and contractors which could be well dispensed with, with the idea that it is only going to cost *a little more;* and if there were not so many of those littles to be included in the items, few buildings would exceed the first amount of outlay agreed upon. Others are fearful of greater expense than they intended to incur, and underestimate their wants, and, seeing the want of many things afterwards, become quite as readily a victim for extras.

None of this is necessary; plans and specifications, fully considered and deliberated upon, are the true basis for economical building.

Deliberation as to time of building is another source of economy. Never build in a hurry, unless circumstances which will cover the additional expense force you. There are always times and seasons when materials can be bought cheaper, and labor be hired for less, than at others; and hundreds of dollars can be saved by taking advantage of circumstances which tend either directly or indirectly to diminish the cost of materials. Ordering goods ahead in plenty of time allows manufacturers

advantages they are always willing to share with you, and your architect will be of great advantage to you in assisting and advising you in purchasing. He is most likely to know where they are to be found, and if not he has the most ready means for finding out.

In the following descriptions of materials and necessary additions to a good house, the reader must bear in mind that we are treating in a general way of buildings costing from one thousand to one hundred thousand dollars; many things referred to, a man of limited means could not afford except in a modified way, and our space does not admit of elaborate descriptions of every way in which the results may be accomplished. But our intention is to call attention to necessaries which are too often left out and cause disappointment.

To be sure, all these things create additional expense in building, and are generally omitted on that account; and we are too often required of our clients to produce more of a building for a stipulated amount than could possibly be done if the building is properly put up and the necessaries added. The best economy does not lie in the fancied saving of money at the outset, but in the adoption of wise plans; and when a man tells you he can put up a cheaper building for you "without so much plans and specifications," or by more modified ones made by himself, make up your mind at once that he can only do it by taking advantage of your inexperience in building, and "skinning" you of many comforts, conveniences, and material actually necessary for the durability of the house.

Cheap houses, fully covering the necessities of a family, are just as readily planned as more expensive ones; just as easily limited in the hundreds as in the thousands. Necessities for such a house are also to have just as much care in proportion. Better far to do with less material than to try and get along with poorer quality; expensive repairs and discomfort rob you of more than the difference of expense,—and the varied experience of an architect will help you to use just what you require, and secure you the highest enjoyment of what you are able to pay for.

IMPROVEMENT OF OLD BUILDINGS.

An old house, well built, pleases more, with the necessary repairs and improvements judiciously added, than many a costly new one.

There are often many good points in the surroundings and plans of an old house which have grown up with it, and which may be adopted as parts worth preserving, and the additions may be made for holding the whole in keeping with the original design. Care should be taken to keep ruthless hands off buildings endeared to us by associations, with their

surroundings of familiar objects, which few but ourselves can appreciate. If some changes are perhaps necessary, have them treated with utmost care. Though some natures may not sympathize with you in the desire to preserve apparently useless relics, there are others who can, and regrets come too late if we permit wanton waste, which curtails our enjoyments and perhaps destroys all we held dear in the associations of our old home.

LIEN LAWS.

In most of the States, including Connecticut, the lien laws make it a necessity for the owner to be assured that all bills of labor and material used in the erection of his buildings are paid by the contractor, as his property is liable, for sixty days from the completion of the work performed and the material furnished, for all amounts due, even if it has been already paid for by the owner to a contractor. And it is a wise and safe course for the contractor to furnish the owner with all bills for materials bought by him for the building, and for the owner to pay them personally, taking receipts "in full for all claims to date," and also to present pay-rolls and bills for all labor, etc., furnished by himself, to the owner for payment as the work progresses.

This course will ensure the contractor of sufficient means to prosecute his work, and a prompt payment of bills for materials, which improves his credit, and also assures the owner against losses. Mutual confidence thus established is the cause of very pleasant business relations between all parties, and ensures the success of the contractor as much if not more than anything else.

INSURANCE.

As a mattor of policy and protection against losses, one of the parties to the agreement should keep in force a builder's risk of insurance, for the benefit of all parties concerned, to the full amount of the building contracts.

SURVEYS.

The contracts for beginning all made, and everything ready, the property should be properly surveyed, setting all building-lines, and stakes at all corners of the building, and on these stakes the levels, from the curb-line of the street, as all heights and depths are determined from that point.

From these stakes the joiner sets profiles for the masons to excavate by and set the foundations. Once started true and level, the upper works are all the more apt to come together and in place and prevent unsightly disfigurements.

PERMITS.

The city ordinances require that application shall be made by the owners to the Common Council for a permit to build, which is referred to a license committee.

The application should mention whether of brick or frame, and request that "it be referred to the committee with power" (to grant), and much time will be saved in obtaining the application by reason of the necessary reference ending with the committee and not required to be referred back for the action of the Council.

Plans and specifications are then required to be submitted for approval to the Commissioner of Buildings or Fire Marshal, who sees that special ordinances relating to foundations, party-walls, supports, fire-coping, fire-escapes, areas, etc., are complied with.

Permits must also be applied for to Street Commissioners for removing sidewalks and placing material in the streets, also for permission to connect with sewers, city water-pipes, etc.; two hours' notice being also necessary to the City Engineer for the inspectors to supervise the breaking into and connection of pipes.

The water connections are usually all made by the city water-works, and the pipes extended as far as building-lines.

The obtaining of proper permits is very little trouble and is for the general public good, and will save annoyance afterwards. We hope to see regular building-laws soon adopted and in force, which have proved of so much benefit in cities where they are in use.

REMOVAL OF BUILDINGS.

The success of house-movers in removing old buildings and passing almost insurmountable obstacles has led them to attempt almost anything in that line which may present itself, and brick blocks are now quite as easily moved as frame buildings. We would not advise an owner to attempt it except with an experienced mover, as it is a business that has to be learned, and there are many precautions to take in reference to the general construction, position of chimneys, etc. Many a building which would otherwise have to be torn down can be saved this way and put on inexpensive property.

When moving a building bodily a mason is engaged to make openings in the foundations for *needles* (timbers), clearing the way of obstructing walls, and getting new foundations ready. All material of old buildings taken down should at once be properly assorted, cleaned, and piled in a suitable place on the premises, ready for use, and all refuse immediately removed.

EXCAVATIONS.

Exeavations for buildings must always be of suffieient depth to ensure against the action of frost,—an average of four feet. Greater depths must be determined by the requirements of basements, cellars, and the nature of the soil to be built upon.

The size of excavation should be one foot wider eaeh way than the actual size of building, to admit of the mason using tools in setting the stone and fitting the joints with mortar, or plastering the face of the walls. After this is levelled off, trenehes are to be dug for footings, twiee the thickness of the eellar walls, to the depth of one foot below the eellar bottoms.

If proper soil for building upon is gained, a good ramming with an iron weight will considerably harden the earth and settle it more than a great many tons of stone-work built quietly into place.

Before building it is neeessary to take preeaution against uneven bearings, and search out all soft spots of quiek-sand, marl, ete. Excavate them and fill them in with a eonerete of broken stone. Borings should be made at several places to ascertain the nature of the sub-strata of earth from four to eight feet in depth, aeeording to the weight of building to go upon it. A strata of this thickness, if it proves good, will hold an ordinary building even when a softer strata is under; but should the building be high and massive the ground must be strengthened by *piling*.

If the ground prove soft, of a loamy nature, reeourse should be had to *cradling*, or a good broad footing of *concrete*. Should it prove watery or very soft, *piling* must be done to seeure a firm foundation. Made ground should not be built upon, but exeavations made to solid bottom.

It must be remembered that all earth is eompressible, the main objeet being to seeure an equal settlement. The settlement eontinues for some time, but is eheeked sooner by adopting the precautions referred to.

When exeavating, lay aside, for a future top dressing, all the top soil that may be needed, piled up one side, and also throw out and leave on the bank suffieient earth to fill in around walls after they are built; this should be done while building to prevent the trenehes filling with water.

The *cost of excavating* depends upon the nature of the soil, and is usually estimated by the eubic yard; and then sueeess in performing the task depends upon the energy and perseveranee of the superintendent, and the advantages of surrounding eireumstances.

The following data will enable any one to approximate the cost of excavating:

One man can shovel out ten yards of sand or loam per day, that does

not require picking. If it requires loosening, one man to pick and two to shovel can throw out twenty yards of earth. If the soil is of clay and not very hard, it requires one man to pick for each shoveler, for each ten yards; harder clay, or a mixture of stone, necessitates more help to do the same amount of work. If the earth has to be removed by wheelbarrows, it requires one wheelbarrow to each shoveler for every seventy-five feet, on good runs of plank. If the earth is to be carted it requires one cart to each shoveler for every 1,000 feet of hauling. In fairly regulated work the men are actually engaged only two-thirds of the time.

These estimates are based upon actual experience in building operations, and all allowances made for straightening banks, cutting out for wings, and grading the earth to levels. Rough work in embankments will amount to three times as much.

PILING.

If piles are driven they should be in rows and sufficient in number for the weight of superstructure: one at least to every eight tons in weight, and in position to give good width of bearings. Piles with flat ends drive quite as well as pointed ones, but pointed ones with iron shoes pass obstructions better and are preferred. If not pointed true they will not drive straight, and if intended to drive close against the next one the pointing is made so as to cause it to hug the next one all the way down. Besides shoes, the heads should be fitted with rings to prevent splitting. The heads of piles should be cut off at a depth of at least one foot below water level, to keep them submerged, and cribbing be built on to receive the footings. Allowance must be made for elastic reaction of soil, as they will settle back to bed when weight is applied. Hemlock trees are the cheapest and best for piles.

CRADLING, OR CRIBBING,

Is a combination of timbers crossing each other to form a bed for the masonry, and should be framed on to piles and notched into each other not more than one-fourth their thickness, and pinned or bolted. The spaces are filled in with broken stone, and grouted with liquid cement mortar.

FOUNDATIONS.

A volume written on this subject alone would not cover its importance, but these hints are all our space will permit, and we particularly caution you that since the foundation is at the bottom, it will prove the *root of all evil* if not a good one, and must not be slighted if you would avoid the principal source of unsightly cracks inside and outside of the building.

It is not enough to trundle in a few large stones, scatter a little mortar here and there, and with seeming anxiety get out of the ditch as soon as possible, with little thought of how much depends on the contents of that ditch, and the way the materials are combined for good or for evil.

Footings should be of broken stone, rammed into the trench, and grouted with liquid cement mortar, so that it will set into a solid mass; or of dimension-stone laid cross-wise to the walls and *well bedded* in mortar.

The walls should be of stone, below ground at least, though brick is sometimes used. Where stone walls are used below ground and brick above, it would be well to project the extra thickness of the stone walls out into the bank, so that the inner face is flush; also over the stone-work lay a *damp course*, of tar and sand, spread over the wall to prevent the suction of water from the earth by the brick-work.

If the foundations are of brick they should be commenced in broad footing courses twice the thickness of walls and racked in to the thickness of the required walls. All brick-work under ground should be laid in all-cement mortar, and plastered a good coat on the outside next to the bank. The thickness must depend upon the super-structure, and be at least four inches thicker above the ground than the upper walls, and eight inches thicker under ground.

STONE-WORK.

Stone walls under ground are usually built of good *rubble-work;* that is, of good shaped quarried building stone, roughly squared, bedded, and bonded, laid up in courses a foot high, and through-stones built in every three feet in each course, all spaces filled in with *spalls* or chips of stone and mortar. All joints of work exposed to view are slushed full of mortar, or pointed, as desired. This kind of wall is strong if well built; if not, most serious results from settlements are likely to occur from action of frost and rains.

A better wall of stone is formed of blocks more carefully squared and regularly bonded, every stone over-lapping, and through-stones more plentifully used. A wall built this way will prove more than twice as strong as a rubble-wall. All buildings of any weight or size should have foundations laid this way in preference to thicker walls laid the other way, as thick walls are only faced on the outside, and seldom well bonded in the center.

The mortar used should be mixed with portions of cement from one-third to one-half, according to the nature of the ground—whether damp or dry. And if ground is watery then all cement should be used, and a coat of cement mortar outside will save much trouble from dampness.

The *thickness of stone walls* depends upon the superstructure, and varies from sixteen to twenty-eight inches for ordinary houses—

Foundations for buildings 20 feet in height, not less than 16 inches.

" " " 25 " " " 20 "

" " " 35 " " " 24 "

" " " 55 " " " 28 "

This will make them as a rule eight inches thicker than the upper walls. Walls next to street fronts must be four inches thicker against vibrations of passing loads. Long walls should be braced with buttresses. All other kinds of buildings require special study of the constructing engineer, to determine the thickness and method of construction.

The *strength of stone* is different in dry or wet soils. Sandstone thoroughly wet will sustain only half as much as a dry stone. Stones will crack with half their crushing loads, 100 tons per square foot, so it is not a good practice to load them over twenty tons per square foot.

COST OF STONE-WORK

Varies so much from the changes of prices at quarries for the rough material, that it is not possible to give an approximate estimate, it varying fifty per cent. within a radius of twenty miles; and labor depending on the care of construction. In each building it must be sought for separately.

CUT-STONE WORK.

The commonest necessities in a brick house are cut-stone sills, lintels, and water-table. To these are added cut-stone string-courses, architraves, paneled dados, angle quoins, etc., cut to represent purposes of construction, sometimes plain and sometimes richly carved in style and finish to suit the taste of the designer.

All *stone trimmings* which project from the walls, such as sills, water-table, and string-courses, should be cut with a *wash*, or bevel top, and with a *drip* on under side, or *throated*, as commonly called, to prevent the water from running back on walls and making streaks at the corners of the stone, as often noticed on the fronts of buildings.

Sills should always be cut with *lugs*, which are level beds at each end on top of the stone for brick jambs to start from. It is very common to see an ugly joint of mortar here and there, or a sliver of brick inserted, which is done to save the trivial cost of five cents per foot.

Lintels are beams of stone over openings, to support superstructures, and should always be relieved from accidental cracking by discharging-arches in the walls.

Ashlar is laid up either in courses or broken work:

In *coursed work* the stone is all of an even height and in a variety of lengths; the joints are set close and pointed in mortar, or channeled, according to the style of finish.

Broken work is square or zig-zag. The square is of promiscuous sizes and set close joint; the zig-zag is of irregular shape and angles, and each stone is fitted to its place and the joints raised and pointed in mortar. The face of ashlar is finished in various ways:

The *Pitch face* is formed, after jointing the stone, by a chisel applied to the sides, which spalls the stone off the face to the appearance of natural rock, showing no tool-marks.

Picked face is the same finish, but picked with a *point* tool to show the tool marks.

Point-drove face is further finished by a point tool driven across the face in parallel lines, horizontally or diagonally.

These varieties of ashlar are usually finished at the corners and around openings with a *chisel draft*, to give a sharp, finished angle.

Chisel face is the cutting of a smooth face, showing marks of chisel.

Hammered face is the cutting of a face with a *bush hammer*.

Rubbed work is done with a weighted stone, sand, and water, with which the cut-stone is ground smooth.

In more expensive work paneling, decorating, and vermiculating (which represents worm-eaten wood) is done in appropriate combinations.

Other work which is not in common use is also well understood by the architect, and has appropriate uses which hardly need mention here; but all owners should notice particularly that stone-work is cut so as to lay on its natural bed—with the edge to the weather. It is very common to put the bed to the weather to show the marking of the grain, and to save the extra expense of cutting; but the frost of a few seasons causes it to flake off and destroys it, unless the stone be of extra close, hard grain.

TERRA COTTA,

Literally meaning "cooked clay," would seem from its name to be very easy of manufacture, yet to produce a strong, durable material requires a scientific knowledge of clays, and their nature. and the addition of ground flint, etc., and the success of the vitrification more than ordinary experience, on account of the variable sizes of the blocks. A simple test of its texture is made with a penknife, which should not penetrate its surface, and will sometimes strike fire on it. It is stronger in tensile strength and under pressure than stone, if properly made, and stronger

than ordinary brick. The true qualities of terra cotta in its application to architecture consist in its merit as a decorative fire-proof material, possessing the three essentials of color, durability, and economy; and when treated with due regard to construction, so as to fulfill its part in the building, it admits of the impress of original art and fineness of execution, pleasing in effects in the hands of the architect. In combination with stone and brick fine effects are gained.

To form it in single designs would be more costly than cutting in stone, and its cheapness depends upon the reproduction of the same design as many times as it can consistently be repeated in the same structure. But although it has these numerous good qualities it must be very judiciously used to prevent the appearance of gaudy cheapness.

It should not be used in projecting courses, as it cannot be made in long pieces, and in short lengths the mortar freezes out of the joints, the corners are broken off under pressure of ice, and it soon shows a weather-beaten appearance. It is far better used in panels, dadoes, spandrils, and in flush ornamentation. It should not aim at imitating those features of stone architecture which require large blocks, for the nature of its treatment should be consistent with that to which it belongs—brick architecture. It is incapable of the high finish and detail which can be obtained in fine stone, and in its colors should not be made to affect the appearance of stone, for the sham is at once detected; but if it is used according to the uses of its class of material, honestly executed, without the aid of concealed supports and ties, it will excite respect and honor for the designer.

We do not recommend its use where stone is cheap and to be had readily, as its contrast with stone ornamentation is depreciative; but where stone is scarce or costly, let it be used with simplicity in the most unostentatious and straightforward manner as an economical building material, and ornamentation, if added, be massed and composed so as to show a certain idea in its distribution among plain spaces, to give effect of contrast.

BRICK-WORK.

Only good, well-burned bricks should be allowed in any brick-work, though it is a common practice to use up the soft brick in the heart of thick walls.

Good brick should have a rich color, and the different shades are assorted to different sides of a house. If good, they will ring with a clear metallic sound when struck together. Bricks that are soft enough to break off at the corners and edges with the fingers, and all swollen brick, must be refused.

Employ good bricklayers, as a poor job is always regretted. A wall should be laid up in courses and bonded every sixth course with a row of headers. Mortar should be used freely, and all spaces filled in solid, and any walls or piers sustaining great weight should also be grouted full of liquid cement, to ensure solidity.

Form discharging-arches for all openings, and avoid building in timbers to nail wood-work to; if it is necessary, use lath or wood bricks. All projecting courses should be *corbelled* out in heading courses, and not projected for cornices more than the thickness of the wall supporting it, or it is likely to overbalance and fall off. Leave channels for pipes. Brick walls are sometimes built hollow, but just as many brick must be used for strength as though they were solid. If so built the outside wall should be 8 inches thick and the inner wall 4 inches thick; and if to insure against dampness, use iron ties of $\frac{1}{4}$ inch by $\frac{3}{4}$ inch, $10\frac{1}{2}$ inches long, turned up 1 inch at each end, and set 2 ft. 6 in. apart; this leaves a $2\frac{1}{2}$-inch hollow space. Plastering may then be rendered on such a wall, but if plastering is to be put on do not use brick for bond, as they will conduct dampness through and the walls will have to be "firred off." All solid walls should be firred off with strips set 16 inches from centers.

Facings of brick should always be of pressed brick, when the limits of expenditure will admit of it, and laid in fine-tempered mortar, which is frequently colored with prepared oxides of iron.

Molded brick give variety of ornament in string courses, cappings to arches, finish to jambs, angles, etc. Care should be taken to assort the different sizes or they will make jagged lines.

COST OF BRICK-WORK.

After computing the cost of brick delivered and covered and the amount of mortar (see article about mortar), the labor of bricklaying may be approximated as follows, allowing each man a helper to keep him supplied with material:

In common house walls a man will average 1,500 bricks per day; in the neater faces of better work, 1,000 to 1,200 per day; in good ordinary street fronts, from 800 to 1,000; in the very finest work, from 150 to 300, according to the amount of angles.

Washing down of brick-work with a solution of *aqua fortis* and water cleans the brick thoroughly, kills the lime-washing, and removes discolorations.

Oiling brick-work is very beneficial, as it develops the color, and creates a film in the pores which helps to preserve a smooth surface.

Painting brick-work is often resorted to where the color of the brick is not good; it does not preserve it, but prevents absorption of water, making houses less subject to dampness. Where paint is to be applied the brick should be rubbed down with a piece of sandstone and cement water, that the pores may be filled up and little incrustations smoothed off.

Fire-walls. All outside walls, and party-walls between houses, should be carried up above the roof at least one foot, and coped with blue-stone coping. They are a great protection against fire when an adjoining building is in flames.

Filling in with bricks. We do not advocate the filling in of frame houses with brick, for if the space, four inches, is filled up by laying the brick flat, as usual, making a solid wall, we find the house usually cold and damp in winter and warm in summer. We advise *inter-lathing and plastering*, as it not only excludes the cold, but admits of enough ventilation to keep the walls dry. The filling in of frame houses with brick one foot high above the sills is an excellent preventative against rats and mice.

STRENGTH OF BRICK-WORK

Is a serious consideration, and these rules cover the average emergencies of ordinary buildings; other special works must be subjected to the decision of a constructing engineer.

The resistance of a common brick is 120,000 lbs.; of pressed bricks, 160,000. So a wall six hundred feet high would grind the foundations to powder. It is usual to calculate a safe load at one-tenth of this, as it is possible to carry up a twelve-inch wall sixty feet high in safety, as to weight, without other supports, if it were not subject to lateral pressures of wind, and danger of buckling, from want of stability; it is necessary to have walls thicker on this account, and each tier of beams built into them adds materially to the same result.

In all dwelling-houses not more than twenty-five feet in height, the walls should be eight inches thick; not more than thirty-five feet, first story twelve inches; above that, eight inches; not more than fifty-feet in height, twelve inches; where they exceed this, and not over eighty feet, the two lower stories should be sixteen inches in thickness.

Party-walls fifty-five feet in height should have the lower story sixteen inches thick, and the rest twelve inches; and where they exceed that height should be twenty inches thick first story, and sixteen inches the rest of the way up. Other buildings than dwelling-houses, or exceeding twenty-five feet in width, and without party-walls, should have all the walls at least

four inches thicker; and buildings situated on a corner should have the exposed side also four inches thicker.

Pilasters, at least two feet wide and not over fifteen feet centers, are of great advantage, and add stability to walls equal to four inches greater thickness.

Bracing new walls should never be neglected, for the mortar being green has no cohesive strength.

The *size of a brick* is usually eight and one-fourth by four by two inches, which is sixty-six cubic inches. In ordering a large number be particular as to size, as one-fourth inch each way less in size will contain only fifty-two cubic inches, thus requiring full twenty per cent. more brick to do the same amount of work, and be more costly in laying, as the same price is usually paid for 1,000. Smaller brick should always be bought for less money, and should not be taken when standard sizes can be had. The cause of difference in size is sometimes from short moulds, but oftener from the shrinkage of the clay in burning.

The *weight of bricks* will average four and a half pounds each, and two tons per 1,000, gross weight. A cubic foot of brick weighs one hundred and twenty-four pounds.

The measuring of brick-work depends on the size of mortar-joints used in the work, they varying from eighteen to twenty-three per cubic foot. The average of twenty-one is used for measurements when not otherwise agreed to. The measurement usually overruns the kiln count of brick used, because of extra allowances for laying which a mason is entitled to by custom in rules of estimating.

STABILITY OF BRICK-WORK.

Stability must not be confounded with strength. A structure may be very strong and yet very unstable, or of weak material and have stability. The stability has reference to the structure in its combinations of masses into one body, which gives rigidity against other forces than those which are crushing weights, and which forces are usually from the outside, caused by wind, which may affect it either by steady pressure or cause vibration and rocking. Vibration internally is the severest test of construction.

The height of a structure materially affect its stability, as the increased height increases leverage.

The precautions to ensure stability are good foundations and the combinations of construction which give strength against transverse strains; and resort must be had to strengthening joint fastenings with bolts, spikes, cramps, joggles, mortices and tenons, mortar, cement, etc.

Partitions, floors, and roofs must all be combined with the outer wall to resist lateral pressure, and it is just as necessary to see these properly attached as it is to see the material properly laid. It is also for this reason that the foundation should be level in all its parts, stepped for structures on a sloping ground, and security against settling in mortar also provided for, where the walls are of different heights.

MORTAR.

Besides the few hints given heretofore about mortar, it is necessary to add these hints, as the proper strength of mortar is needed to give the materials their proper value against strains and pressures; and as it is affected by extraneous circumstances, the best judgment must be used in the proportions, so as to overbalance the possibilities of injury.

Lime mortar is readily affected by moisture in damp situations, absorbing it from the ground, and also from the air, in situations not dried out by sunlight or air; and it is a common thing for it to remain soft without setting for several feet up from the ground; in such cases cement must be added. Moisture also affects cement, but with a tendency to harden it.

Sand used in mortar must be sharp crystals, to give the best surfaces for cohesion of lime or cement, and must be free from clay, which prevents adhesion, and from salt, which draws dampness, causing the walls always to drip and be moist.

The crushing resistance of mortar is two tons per square foot, as ordinarily used; with less sand it is stronger. Mortar made too rich with lime will also be too slow in setting, the strength of mortar depending on the perfect mixing of the ingredients.

Frozen mortar is ruined if once thawed out, and walls put up in freezing weather should be of mortar well mixed with cement, to cause the proper set before it can possibly thaw. Walls thawed out and improperly set must be taken down and rebuilt, as they are liable to fall down and cause much damage.

Lime to be of use must be fresh, and protected from the weather until used. Lime well slaked requires time in order to properly dissolve the grain, and the longer the time it has the better.

The proportion of one measure of lime to five measures of sharp sand is commonly used for light work, but where the walls are made thicker and require greater strength the proportions of lime are increased to one part to four and one part to three.

Bricks as ordinarily laid in mortar will use sixteen bushels of sand, or

twenty cubic feet, and from one barrel to one and one-half barrels of lime to each thousand of brick; the proportions of lime used depending upon its quality and the richness of the mortar required. Brick dust added to mortar renders it hydraulic.

Cement mortar is mixed in proportions of one measure of cement to three of sand for light work, and one measure of cement to two of sand for heavy work.

The addition of one-third part cement to two-thirds lime makes good mortar for brick-work put up in variable weather, or in exposed situations, and in proportion of half and half will be as rich as need be for most emergencies. It is also best for all stone-work under ground subject to much moisture or superincumbent weight. Sixteen bushels of sand, one barrel of lime, and one barrel of cement will make mortar sufficient for properly hearting one hundred and ten cubic feet of good rubble-stone wall. In dry weather bricks should be wet to prevent absorption of the moisture from the mortar; in cold weather it is not necessary, as the brick are not so absorbent, and the freezing of the water would injure them irreparably.

PIERS,

Where necessary to be used, should always be as large as possible, and if subjected to any weight should be bonded with stones the full size of pier and from three to five inches in thickness, according to size of pier. Piers should always be capped with stone; wood caps are invariably the source of serious trouble in the plastering afterwards. Give them good foundations, at least one foot larger each way. A safe rule of strength is never to let their height exceed eight times their diameter. Build them always of hard brick and grouted in cement mortar.

CONCRETE

Is formed of broken stone, even in size, and large gravel, all well laid and rammed down solid, and a grouting of liquid cement poured into it and set in a solid mass. For cellar bottoms it varies from four to six inches in thickness and is afterwards floated smooth with a good coat of cement mortar. If used for foundations the width of trench is always at least twice the thickness of wall, and more, as circumstances require, and laid in courses not exceeding eight inches, and grouted in each course.

Our experience has proved this to be invaluable in many cases, even where piling was unsatisfactory, having built it over beds of quicksand and marsh.

CHIMNEYS.

There are a great many things connected with the position, formation, and finish of chimneys, usually neglected or done without proper judgment, and greater care must be exercised to prevent the numerous difficulties built in with them, and to prevent the frequent fires emanating therefrom.

The chimney should always be placed with reference to doors and windows, where there is a draught, or an opportunity for creating one. A fire-place in the same wall with an entrance door should be avoided, as the halls will, on account of their greater height, draw off all the heat from the room. They should not be built on the outside walls, as the draft of the flues are checked by the outside temperature, and the windows too often become the means of escape of all the warmed air.

Flues should be as straight as possible, and if there must be a bend let it be near the throat, the ingenuity of inventors being taxed to remedy thoughtless work in malformations. The height of the chimney should be sufficient to ensure a free play of the wind over it, without obstructions, and also of the influence of roof formations which create back draughts. Plastering of flues is of no use, as the action of soot soon destroys its hold and it drops off; a smooth-struck joint is better. Flues starting from the cellar should be furnished with soot boxes in bottom.

All flues carried up through rooms without fire-places should have six inch sheet-iron *thimbles* and tin covers for stove-pipes. A great improvement in forming flues is to line them with glazed earthen-ware pipe, as an extra precaution against fire and to ensure a better draught. Flues for furnaces should be lined with fire-brick at least two feet in height at entrance of pipe.

Fire-places should be well backed and throated, and also connected by an ash flue to a pit in the foundations in cellar.

Hearths must be provided for, whether of stone or brick, with hearth arches underneath, corbelled out from chimneys.

The topping out of chimneys should be done with projecting courses to lap over roof, and the capping courses set in cement mortar, the tops of projecting courses sloped off. Stone cappings are always an improvement in durability and finish.

Fire-place fittings. Material, such as brick, mortar, and plaster of Paris, should always be specified to be provided for mantel and grate setters, in cases where the owners reserve the right of furnishing the mantels.

AREAS'

Are used to all entrance ways to basement, and around all windows which extend down into the ground. They are usually built with stone walls extending at least one foot below area bottom, and coped with cut or dressed-stone coping. The bottoms should always be lined, and a hole cut through the flag for the escape of water, and connected with the pipe drains, or a cesspool formed of broken stone under it, that the walls may not be affected, or dampness created in the cellar. Areas for windows can be formed cheaply by setting a four-inch wall with brick in a semi-circular shape in front of it, and backing it up with waste stone and earth.

DRAINAGE.

All persons building should realize the importance of perfect drainage, and while a few persons can live in a poorly drained house despite all its ills, the majority are very sensitive to the effects of bad drainage.

Sanitation requires equal care in other directions, which is considered under proper headings, but as the system of plumbing and modes of exit for water are by a common drain, it becomes us to see that it is the best system obtainable.

Tap the sewers if accessible; if not, provide proper cesspools at a depth sure to secure ample fall of water. Suction created by a rapid exit of water removes possible obstructions and keeps pipes cleaner—the velocity of waste being greater in a pipe nearly full than in a larger one half full. Six-inch pipes usually accomplish all an ordinary house requires, and is the size commonly used, being preferable often to a larger one, as the water has an opportunity frequently to flush it, and gathering scum, which is a source of disease, is removed.

Make all connections tight with cement, and when laying it be sure none are left broken or set astray, and that the pipe is bedded the whole way in mortar to prevent the weight of earth above breaking it. The most careful supervision of this work will relieve the owner of future anxieties. It is particularly noticeable how slight an obstruction will cause particles of waste to remain in the pipes to send back noxious smells, usually attributed to the sewer.

Beside this drainage, in all soils showing springs, or possibility of water accumulating, there should be proper wall-drains laid, connected with a cesspool filled with broken stone, and connected thence to sewer, if convenient. Several other ways will accomplish like results, which the architect will suggest to suit circumstances.

LATHING.

All wooden partitions, ceilings, and brick walls, if firred off, are covered with laths of pine or spruce, split or sawed. They are about one and one-half inches wide, one-fourth inch thick, and four feet long, and set not less than one-fourth of an inch apart. They must be put on in broken rows, called *snatching*. They come in bundles of one hundred each, and one thousand will cover sixty-five square feet of surface, or about seven yards, allowing for waste.

PLASTERING.

The plastering of the inside walls of a building, whether done on laths, bricks, or stone, generally consists of thin separate coats of mortar, the first a *scratch*, (or rough coat scratched with pointed laths to give a clinch to the next coat,) made up of one measure lime, four measures sand, and one-third measure of cattle or horse-hair; goats' hair is sometimes used, as it is longer. Care should be taken to cool the lime thoroughly before mixing in the hair, and hair if rotten is useless. The hair is used to prevent the mortar from coming off in patches when shrinking. When this coat is set, but not too dry, a second *brown coat* is applied; if too dry, it should be dampened a little. The brown coat is of the same rough mortar or coarse stuff, and before it becomes dry it is roughened a little with a hickory broom, to give the third coat a better hold. This third coat should be used; the frequent occurrence of uneven walls, however, often shows it is not where it can be avoided.

Two-coat work is resorted to by many to save expense in labor of one coat, and the first coat is made thicker. Even if care is taken, it does not gain so good a clinch on the lathing as three-coat work, for the first coat is put on for that express purpose, the second to gain thickness and true straight surfaces, and the finish is the white coat, as usual. Good effects are gained by finishing the *brown* or *second* coat with a fine-screened gravel, giving the pleasing effect of buff-stone blocks, when scored off to imitate the joints.

In brick walls intended to be plastered, the mortar joints should be left rough for the plastering to adhere to, or if smooth, they must be raked out to give a clinch. Brick-work to be plastered should be washed down to free it from dust, and dampened, or the plastering will not stick.

Always see that the plastering is carried down to the floor, and by this means avoid as far as possible any space back of the face-board for vermin to gather. Also plaster behind panel-backs, under windows, and

where the sub-sill rests on the stone sill, to prevent the cold air and snow from drifting in.

The *third coat* contains no hair, and for giving it a white appearance more lime is used—perhaps one part lime to two of sand, the purest white sand being used. This is called *stucco*, a name also applied to mortar used on the outside of buildings.

Instead of stucco, the third coat may be of *hard finish*, or *gauge stuff*, which consists of one measure of plaster of Paris to two of quicklime, without sand; but it is the practice of plasterers also to add some white sand, and it is called a *bastard* or *half-finish*, or a *sand coat*, just in proportion to the quantity of sand used, plaster of Paris being simply used to harden it. A stucco wall is best for painting in oil.

Either of these coats is smoothed or polished to a greater or less extent, according to the taste, whether it is to show, be papered, or painted, etc. The polishing is done with a hand trowel, or a float (which is a kind wooden trowel), and the water brush. The more the work is gone over with the trowel and brush, called floating, and the brush wet with water, the harder it will be, and the higher the polish.

The rough surfaces and unevenness of walls must be set true by *screeding* in the second coat. Screeds are long gauge-strips of mortar set on walls, and set true to a long straight-edge called a *screeder*.

The preparation of mortar for plastering is an important item, if good work is desired. The paste of lime should be slaked and cooled at least one or two months before using, and thoroughly sifted through a very fine seive, for if little pin-heads of lime unslaked get into the plastering they will eventually burst and cause little *pops*, and look pitted, as if with the small-pox.

A plasterer, aided by two laborers to mix his mortar and keep his hawk full, can render about two hundred yards per day on straight walls, about one hundred and fifty yards if there are angles to turn, and one hundred yards on ceilings, of first coat, about two-thirds of this amount of second coat, and about one-half of third coat, or finish, the amount depending on the number of angles and the fineness of finish. If put on by the yard, stipulate to pay for surfaces covered, and thus avoid extras, even if you have to pay a few more cents per yard.

The quantities of materials and labor for one hundred yards of plastering, three-coat work, will approximate to five barrels quick-lime, one-half barrel plaster of Paris, two thousand lath, four bushels of hair, seven yards common sand, two and one-half bushels white sand, thirteen pounds of nails, four days' labor for plasterer, and three days for laborer. *Two-*

coat work makes a difference of one and one-half barrels of lime, one yard of common sand, one-half day less for plasterer, and one day less for laborer; the difference in price is about five cents per square yard in ordinary work, and more if the three-coat work is of a higher finish.

Plaster cornices are run in a muffled mold, with a mixture of plaster of Paris and lime putty. Plaster cornices will crack if poor plaster is mixed with good, as the common sets the most quickly. It is a common practice to mix glue with plaster when the quality is uncertain, as it causes the whole to set slower.

IRON-WORK.

Iron has furnished the building trades with great varieties of means for overcoming the emergencies incident to a strong structure, lightening the massive walls, and sustaining immense weights where little room could be afforded for bulky foundations. The knowledge of its powers in various forms and cross-sections is yet imperfect, and the rapid change in expansion and contraction in our variable climate presents difficulties that must be provided for where it is exposed.

Its use should be guided by the best experience of the constructing engineer, and every piece made sure of for its purpose by a practical test under pressure of at least three times the possible weight, noting the deflections and elasticity by the use of carefully adjusted instruments.

Under compression cast-iron gives results over wrought-iron of two to one, while in tension wrought-iron reverses the rule. Combinations of the two are often used in proportion to cover these differences, or either is used and extra allowances made in quantity to cover possibilities of the existing strains.

Variation in strength of various iron ore used is from ten to fifteen per cent. All possess elasticity, but each successive strain to its full bearing capacity separates the grain and weakens it. Cold weakens iron materially.

Hollow shafts, either in compression or tension, are stronger than solid ones of the same area of metal.

A square column has one-fifth greater bearing surface than a round one.

The strength of a column to provide against possible contingencies is put at ten to one of its crushing strength. Columns with the ends planed off true and set with bed-plates will bear ten times as much as one simply squared or chiselled into place. A column out of plumb will only bear one-third as much as one set true.

Columns formed of segments of rolled iron answer for common work as well as cast-iron. Cast-iron columns are sixteen times stronger than wood of the same area.

Girders are made of cast-iron or wrought-iron, with web and flanges to provide for transverse strains, and should always be tested before use. Rolled-iron beams with flanges top and bottom, and coupled together with bolts and separators, form excellent girders.

Girders having the weight distributed over their entire length will bear twice as much as those with the weight at center; those concentrating their weight at third distances will bear only one-third more, and persons using them should be careful when ordering to make mention of the fact as to the position of piers.

Over all girders used the brick-work should commence with a discharging-arch, three courses of rowlocks, and of the full thickness of the wall. Girders have flanges top and bottom because it strengthens them in proportion to their depth.

Beams of rolled-iron make most excellent systems of construction in combination for the support of floors, and in places where a wooden girder would appear as a blemish.

Care must be taken, in examining iron goods, to search for defects often carefully cemented in with iron cement and painted over, also to note that the body of the metal is of the same thickness as the ends, as it is frequently thinner than it shows. A pair of calipers will determine the probabilities.

To provide against fire all columns should be doubled, and the inner column made sufficient for the weight, so that if the outer shell is destroyed the building may yet be saved. A coating of plaster of Paris and wood ashes make an excellent protection against fire for all iron-work.

Iron anchors, for securing beams into brick-work of houses, should be three-eighths by one and one-half inch iron, with six inches turned up into walls, and one inch turned down into the beam one foot from the wall, and nailed with two wrought nails one-fourth inch thick, one anchor to be used to every fourth beam, and to all trimmers resting on the walls. Where these beams overlap girders or a brick wall, use strap-irons, with an inch turned down into the beam at each end.

Bridle-irons and stirrups should be used for timbers framed together, that the weight may not be entirely on the tenons.

Angle-irons should be used in all exposed corners of brick and stone houses, built into the walls, and extending well back into the masonry.

Tie-rods should be used freely where small piers are put up, to prevent lateral settling.

Anchor-bolts should be used to secure the roof-plates to brick walls on all buildings having pitch roofs.

Miscellaneous articles in iron-mongery are also to be provided, the names of which will suggest their uses.

JOINER-WORK.

Good joiner-work is a source of pleasure to all owners, and no part of the work of building tries the skill of builders more than this; and the increasing expense of the softer varieties of wood is adding material embarrassments to their labors.

The selection of the material and the cutting of it up to secure the best appearances of the stock requires thought and experience, and its qualities as to strength the most careful consideration of the engineer. Seasoned lumber is twice as strong as green lumber and is difficult to obtain; all lumber used for finish that is exposed to view should be *kiln-dried* before using.

The labor of joiner-work is now divided up into several branches, and it is a curiosity to see a shop where all branches of joinery connected with building is done. Machinery has wonderfully improved the resources, so that now the builder carefully lists the quantities of the manufactured goods and rough lumber separately, and sub-contracts them to appropriate tradesmen.

The introduction of new systems of finish and workmanship has greatly improved the beauty of the work, and done away with numerous combinations of surface moldings, and the consequent gaping of opening mitres, and the art of construction in finish now obtains artistic results at very low cost which ten years ago was not attainable without great outlay, and the few men who refused to bend their work to suit the caprice of gingerbread fashions, have succeeded in bending fashion to their will in workmanship, to universal benefit.

ECONOMY IN THE USE OF LUMBER.

It is a matter of intense interest to all, and the President's messages call serious attention to the rapid waste of our forests which is making the price of lumber higher. Economy in use of materials has called for the best energies of constructing engineers to devise methods of construction which will accomplish that result; and though it is hard to get men with fixed notions of building to adopt them, the principles are rapidly gaining ground, and some are reaping their reward by using them, in making more money out of their work and putting up buildings at lower prices. The structures are just as strong, if not stronger, and in this age of advancement of science and arts, a man who ridicules theories tampers with his

bread and butter, while he should be up and doing all he can to prove those theories practical, and to his pecuniary gain. Expensive machinery now tests every form of material and construction, so that a few minutes' work gives the results it would otherwise take years to determine.

A practical worker on principles has the pleasure of knowing beforehand what his work will do, while a bungler is constantly making amends for errors—to his loss; sometimes he is right by chance, but because a house stands it is no guarantee of its durability, for the numerous accounts of so-called accidents show that when tested they failed of their purpose. It is the judicious combination of theory and practice which makes the best results, and no man secceeds who follows either to the exclusion of the other.

Wastage in working lumber nearly averages one-fourth the whole bulk, and in ordering, that much allowance should be made.

STRENGTH OF TIMBER.

Timber used in construction is subject to crushing, tensile, and transverse strains, often in the same piece; therefore its shape as well as size has a marked influence in regulating its adaptability, and the manner of use its durability. The strength of timber varies materially with the age of the tree, the locality of growth, whether the piece is from the center or outer portion of the tree, the straightness of grain, knots, number of rings, etc. From the time it is tapped as a green tree until erected in place it is subject to influences which either add to or detract from its value, even to its position; and should a stick in use happen to be placed with the natural top of the tree downward, it will show it by rotting at the end placed downward sooner than if placed in position as grown in nature, the laws of structure increasing evaporation and keeping dry a stick which is properly placed, but obstructing evaporation when reversed.

When subjected to crushing strains a piece on end will bear ten times as much as it will if placed on its side, so that all lumber used for blocking up weights should be cut and set on end.

Comparative value of other timber with pine is as follows: White oak, 1.45; hemlock, 0.90; white cedar, 0.60; spruce, 0.85. Shrinkage is one-sixteenth as great endwise as crosswise. Timber used as pillars or posts may be approximated as follows: 800 pounds per square inch is the safe load of timber not over 8 diameters in length: 10 diameters, 620; 12 diameters, 525; 14 diameters, 460; 16 diameters will hold only 400 pounds. At 30 diameters a piece of timber will hold 50 pounds per square inch. Any load upon it above this, unless supported by braces, will

cause it to bend at the center, and the distance apart of braces will determine its value. Morticing reduces the strength in crushing strains exactly in proportion to the amount of timber left, but does not materially affect it for transverse strains.

When framing a tier of beams, provision must be made for *trimmers*,—extra-size pieces to support the tail beams, stopping at the stair-wells and chimneys. These trimmers should be of sufficient strength to carry the whole weight of the floors between them, and calculated for the same as girders, and be twice or three times as heavy as the floor-beams. Morticing these for the headers is not a good practice, *stirrups* should be made of iron, and the headers hung into them. Beams directly under partitions, and running parallel with them, should be doubled. No beams should be placed nearer than eight inches to any flue. It is false economy to use light floor-beams, as their constant vibration when walked upon is excessively annoying and unpleasant. All floor-beams should be thoroughly cross-bridged at least once in a twelve-foot span, and twice in any span from fifteen feet upward.

The cutting into beams for gas or water-pipes should never be more than two feet away from the ends, and in depth not more than absolutely necessary for the size of the pipe. The reckless cutting by pipe-fitters seriously injures many a good building, and should it be thoughtlessly done, boards should be well nailed on the sides of the beams cut to preserve the strength.

Beams should never rest upon inside partitions, but be carried through the whole width of the building to the outer frame or brick wall, or, in wide buildings, to girders, provided specially for them to rest upon.

Tensile strength of wood varies from one thousand to two thousand pounds per square inch, and is one-half as strong as cast-iron. Cohesion does not change in regard to length, therefore a piece may be used of any length which has a true grain; pieces spliced together lose strength.

Best results are obtained from small sizes, whereas large timbers are invariably affected by all the weakening conditions. The most durable structure is obtained from combinations of construction, and where certain strength must be obtained those principles must be put in force to ensure the work being satisfactory. Timber will vary one-third in strength, and even with a safe load a beam may bend too much, therefore the deflection of beams at center is of first consideration as to strength.

From these deductions it will be seen that it is better to use smaller beams for floors and closer centers, and girders of constructed pieces.

A beam cut nearly square in its section is subject to the greatest deflec-

tion, used as a floor joist or girder, and its stiffness and strength is increased in proportion as the depth is increased over its thickness, when braced against twisting by bridging, or provided against transverse strains. In proportion as a beam is twice, three, or four times the depth of another beam of the same thickness, so will the strength be four, nine, or sixteen times as great.

An excellent rule of approximation in our practice will be found of value in approximating the strength of any piece of timber with the weight at center:

Multiply the breadth by the square of the depth, and divide the product by the length in feet, and multiply the quotient by seventy-five.

$$\frac{\text{Breadth} \times \text{the square of its depth}}{\text{its length in feet}} \text{ and the quotient} \times 75 = \text{the strength.}$$

If the weight is evenly distributed it will hold twice as much. To determine the load a tier of beams is subject to, multiply the length by the distance between centers in feet and parts of a foot; if they are for a dwelling-house multiply that amount by 75; if for a public hall, by 120; if for a store, by 200; if for a shop or warehouse, by the actual weight of goods, etc., liable to rest upon it; and if for machinery, allowances are to be made for position, vibration, etc.

To determine the weight upon the girder or header, multiply the length of girder or header by the length of beams in feet, and this product by the weights, as above mentioned, according to the use of the building.

The distance between centers is determined by the size of the beams used in proportion to the calculated weight. Girders strengthened on the upper and under sides increase their strength in proportion to the depth of the beam. This is the reason iron girders have flanges top and bottom.

TRUSSES.

When the space to be spanned by timbers is so great that single beams deflect too much under given loads, resort is had to compound beams, called trusses. Engineering has achieved great success in determining relative values of the many combinations made to meet different emergencies. The old conventional forms with their imperfections have been rapidly replaced by new ones which have the merit of doing the work assigned them so that there is little excuse for roofs caving in. And while we mention a few facts connected with them, the limited character of this work will not permit any elucidation of the principles, but we respectfully caution all persons not to adopt any form of trussing without

consultation with known experts. Many roofs and buildings are full of extra rods put in to counteract defects that might easily have been avoided.

Horizontal pieces are called *chords* or *ties;* oblique principals, *rafters;* vertical pieces, *posts;* and besides these are *suspension-rods*, *braces*, *struts*, *counters*, *straining-beams*, etc.; and these are used in single and compound combinations.

In framing a truss, whatever the principal bears up is the amount of the strain on the lower chord. Counter-rafters, or struts, only aid in strength when the downward strain is counteracted by rods or bolts. All timbers used should be constructed with every piece perfectly in bearing, so that crushing weights would affect all pieces at the same time. All joints must be planed true, and set firmly, and bolted against counteracting strains, because strains by wind often reverse the purpose of timbers on the opposite side from the exerted pressure.

Rafters assume the work of pillars, and have also a vertical strain transverse to themselves, which makes it a necessity that they should be of greater depth than thickness. Tie beams also have transverse strains, yet the final calculations show them to be nearly square, and it is a mistake to treat them in the same manner as floor-beams, in calculation of strength and bearing.

Deflection of trusses is not always an evidence of weakness, but elasticity of the timber may be greater than use may warrant.

Trusses should always be braced laterally against transverse pressures; it is common to neglect them, and leaky roofs and cracked walls are a natural consequence.

It is the practice of some to diminish the size of rafters from the foot to the head, but the saving in weight effected would be better if left on, and the expense of re-sawing uses up all the saving in cost of lumber.

The pitch of a roof truss is determined by the style of building and the materials for roofing. The greater pitch of roof, though it gives greater area of roofing materials, makes a saving in timber and construction,—often a consideration.

A truss well constructed will bear the same weights when inverted, except that the purpose of every piece will be reversed.

FRAME BUILDINGS.

The construction of a frame house is supposed to be from some fixed principles, but the varied notions of joiners would make it difficult to decide technically to what tribe the species belonged. So long as there is

timber enough, well braced and joined together properly, the ready adaptability of wood to any desired fancy of form and design usually makes it safe in construction; and without attempting to define systems of construction, our purpose is only to give hints which will aid, in any form of construction, to attain the results.

All framing should fit snug. and when raising, the too handy use of a chisel should be avoided.

A snug tenon, well pinned, is of important value. It is our practice to set all joist, studding, and rafters at a unform distance of sixteen inches, so that beams and studding lay side by side, and then spike them firmly to each other. Notching out, or mortices, should never be more than one-third the depth of the timber.

Bracing should be very thorough and notched into principal timbers. Studding should be doubled around all door and window openings.

A good practical architect will exercise his best ability to gain the maximum strength with the minimum amount of timber, using smaller timber more frequently placed, as shrinkage is sure to occur from seasoning, and plastering expensively decorated thereby grievously injured.

COVERINGS FOR FRAME HOUSES.

The mode of covering most in use is narrow strips, called clapboards, made in a variety of patterns, plain, beveled, rebated, and put on horizontally. Always use rebated boards of whatever style to overlap an inch, as they fit to the frame more snugly. Another method is to use tongued and grooved pine flooring with the outer shoulder bevelled, or rebated to form a channel joint. The narrower the boarding or clapboarding, the less shrinkage. Vertical boarding is sometimes used and the joints battened.

Clapboards above described are from one-half to seven-eighths of an inch in thickness; the thicker kinds may be used on cheap houses without under-sheathing, but the thin ones do not keep out the cold winds without it. Special care must be taken to get them perfectly well seasoned, as serious defects are sure to occur.

Under-sheathing may be of any cheap, sound boards, planed to an even thickness and well nailed to studding. Tonguing and grooving is an improvement, but adds to the cost. Over this sheathing is usually put a sized paper felting which effectually excludes all cold air, and thus makes a saving in fuel.

When putting on clapboards it is usual to butt them, making neat, tight joints against all corner boards and casings; but a better plan is to under-rebate the casings, etc., an inch to receive them.

PARTITIONS.

All partitions should be commenced directly from the brick foundation-walls or girders, and not from the top of the joist. On each story a plate should be placed, and the partitions of the next upper story built directly upon this plate.

If not directly over each other then they must of necessity start from the top of the beams, but if the beams are placed sixteen inches from centers, the studding should rest directly over them. It is poor economy to try to save a strip of studding by building directly upon the flooring, as often carelessly done. Partitions with none directly under them should be braced, to form a truss, over the span; and all principal partitions with others resting upon them should be cross-bridged thoroughly. Partitions should be made as a part of the whole construction of the building, and conduce to its strength, and not be a simple dead weight upon the floors. Their construction should also add stability to the whole edifice.

ROOFS.

This part of the building is put up to suit the forms of the plan, and with such additional features as the designs suggest which will add to the appearance of the building. Much more attention than is usual should be given to it, and it is poor policy to economize in its construction.

It is always best to anchor the plates to the walls, if a brick house, and use a few strap-irons if a wooden one; also bridle-irons at angles of plates and hips.

Valley rafters should always be increased in strength, and if the upper roof is decked, good stout posts or braces should be used, forming a line of support from the nearest partition-walls.

Often chimneys are so located as to assist materially in supporting a roof; a few courses corbelled out to receive braces would be of great advantage; still, it must be the rule of construction not to rely upon them for any support, as they are liable to be removed, or settle away from the timbers.

After the framing is all done the sheathing is to be put on and well nailed. We prefer tongued and grooved sheathing, planed to an even thickness, and a layer of felting over it, as it excludes wind and snow if the covering be slate, and deadens the sound if the covering be of tin.

Back plastering, with a rough coat of mortar, adds largely to comfort and warmth in a house.

ROOF COVERINGS.

Slate should be preferred to shingles on a pitch roof, as it is more durable, fire-proof, and has a neater appearance. The value of the house is also increased more in proportion than the difference in cost, and your insurance premiums are less.

Provide for and put on proper *tin flashings* around all chimneys, dormers, scuttles, sky-lights, on all hips, and in all valleys, run well up under the slate, and nailed. All flashings should be of XX tin, and painted both sides before using, and all exposed joints and nail heads soldered. Besides flashing, the two first courses of slate up from gutters and in from valleys and hips, and around all chimneys, etc., should be well cemented. Sometimes a layer of mortar is spread over the whole roof, which is advisable and adds to durability. All slate should be laid with two inches *over-lap* on small slates, and three on large; that is, the surface laid to weather should be half the length, less the lap, which allows the next course to break joint over it, and to extend three inches above the joint, as a provision against the drift of snow, etc. This makes the slate lay double and the laps triple.

All joints must be made over the center line of width, and each slate nailed with two galvanized nails, wrought nails to be preferred.

Slate comes of different sizes, and should be straight, of good even color, not too thin, and about sixty to the foot in thickness. The sizes best for use are 7 x 14, making 374 in square of 100 feet; 9 x 16, 246 in square of 100 feet; 11 x 20, 154 in square of 100 feet; average weight, three pounds per square foot.

The pitch of a slate roof should not be less than one foot rise to two feet in run.

The best slate shows a metallic glistening surface, and rings well. The dead color is indicative of softer material, and it fades sooner, splits more with frost, and becomes weatherworn.

SHINGLES.

Shingle roofs are flashed in same manner as for slate, and the rule for laying is one-third of length to weather and two inches overlap. Shingles should be sized as nearly as possible, so as to break joints at least two inches over the one under; and shingles less than four inches wide, used over the center of very broad ones.

The sizes are generally from eighteen to twenty-seven inches long, four to seven inches wide, and one-fourth of an inch thick at the thin end, and five-eighths of an inch at the butt.

White cedar shingles are the best to use and the most durable. . Cypress about half as good, and pine still less. Split shingles out-wear sawn shingles two to one.

Eighteen-inch shingles lay 130 square feet to the 1,000, larger shingles laying more in proportion. Shingles wear from six to twelve years. Two good coats of linseed oil will preserve them a long while, and painting them helps, the same as any other wood-work. Shingles are usually laid on lath two and one-half inches wide and one inch thick, set eight and one-half inches apart.

TINNING.

Tin roofing, to be good, must be put on with care, well turned up and over all angles, and flashed around all openings. As it is subject to expansion and contraction, leaks are always the result if proper allowances are not made. This is provided against by a raised standing joint, which costs a little more but pays better by lasting longer; a flat joint is cheaper but not durable.

Tin should always be painted on the under side of the sheets before using, as the sweating from condensation of vapor causes it to rust readily.

Tin roofs should be painted thoroughly every two years, and in angles every fall.

Tin sheets are 10x14 inches in size and of different thicknesses, sized by X, XX, and XXX. XX is best for general use, as the metal is thin, pliable, and less liable to crack under strain of contraction than thicker metal; anything thinner rusts through too easily. It is known amongst makers and dealers by different brands which designate the quantity of tin actually used. Tin is bright, and of a silvery color; adheres in large smooth flakes. Compositions of lead and tin, or zinc, are a dead smoky color, and last but a short time under the corrosive influences of salt air, smoke, and acids, these being the principal causes of its decay.

While speaking of tin, let us remind owners to see to all flashings, as before mentioned, and to window-cappings of frame houses, connections of piazzas, bays, porches, etc., that tin is freely used to prevent future difficulties, and leaks which are a mystery to many people.

COMPOSITION ROOFS,

If properly made, are just as costly as tin. They are made with two or more ply of paper with asphaltum between, and also well spread over with tar, pulverized slate, sand, or gravel, to give them a hard surface. Such good results are sometimes attained that it encourages their use, but

caution must be used by all to investigate the work of those putting them on, to get a good job. The principal advantage is in the saving of painting and easy way of repair; but as the heat of summer affects them, they must be overhauled every fall and any suspicious cracks filled up. Though they may not leak then, they may be already rotting out the paper so that a leak is sure to occur.

All kinds of roof coverings need far more attention by owners than they are willing to give, and it is not surprising that they soon cause trouble when not attended to. They are subjected to all changes of weather, strains of wind, internal influences, the atmosphere and the elements of smoke, besides the numerous acids thrown out by factories which fall on them in showers. If you want a comfortable time in the interior look out for your roofs.

FLOORS.

All floors are much improved by being laid double; that is, with a rough flooring of common boards planed to an even thickness and used until all plastering, etc., is finished, then over this lay a flooring of tongued and grooved boards of the wood determined upon, either pine, spruce, or hard woods. All floorings should be well kiln-dried before laying. They vary from two to six inches in width, and the narrower widths shrink less. Each board should be well cramped into place, and no two heading joints to come together, and be well secret-nailed to each beam.

If the floors are of hard woods, give them a coat of good patent filler, and two coats of heavy coach varnish; this may be pumiced down to any fineness of finish, and will bear waxing, and not dry out when the sunlight happens to touch it. If they are to be painted, all cracks should be filled in with putty. A good mineral paint will wear the best.

DEAFENING OF FLOORS.

A layer of paper felting between the flooring adds to the warmth of a building, and also deafens the floors. It is also the practice to put in rough boards between joist and rough-gauge mortar in the spaces as a deafening. Deafening should be done when it can be afforded, as it prevents the ceilings underneath being stained, prevents rapid spread of fire, deadens all sounds, and adds to comfort of home.

STAIRS.

Stairs to be properly constructed should have their rise and tread in proportion to the natural walking step, otherwise they will be tiresome and annoying to the person using them. The average measure of step agreed upon is twenty-five and one-half inches.

The width of tread is determined upon according to the space left for stairs, and varies from nine to twelve inches, the width for a dwelling being ten and one-half inches, and greater widths for public structures. This amount is deducted from the length of step, and half the difference gives the rise of the step; thus, ten and one-half from twenty-five and one-half equals fifteen, one half of fifteen is seven and one-half, the rise of step. Stairs should have ample room for run and not be cramped for head-room, it being very unpleasant to feel forced to duck the head under the upper floor.

Stairs which are constructed with landings for rest are preferable to long continuous runs, and all differences in height of story in different parts should be provided for between these landings, and not in passage-ways, as is often done.

In constructing stairs they are put upon timber carriages, the side pieces, called strings, are of good sound lumber, and cut out to receive the treads and risers, (called housing,) and these are cut flaring to admit of wedges being inserted and glued in. Each step should also be blocked in the angle on the under side with pieces of wood glued in to make it solid and prevent creaking. The finish is executed to suit the character of the rest of the interior.

Newel-posts are more or less elaborate, and are best made of pieces glued up and solidly joined and dowelled together. Rails and balusters are molded, and their finish is subject to the will of the designer.

While referring to main stairs it is necessary to describe rear stair-ways, which are sometimes open, or housed in between walls. They should always be provided with rails to prevent accidents. Sometimes room is scant to make regularly proportioned steps, but it is best always to plan for good, roomy stairs, as they save broken limbs and painful accidents.

Attic stairs are usually enclosed and a doorway placed at the bottom, so that the heat of the rooms may not escape to the roof.

Avoid winders, except when absolutely necessary to economize space, as they are always dangerous.

Provide step-ladders to scuttles and plank stairs to cellars.

STOOPS

Should be broad and roomy, and wherever possible sheltered by projecting roofs, and provided with side rails. There is no economy in a poorly constructed stoop, which is the approach to the house, and if well proportioned gives the first impression to a visitor of either pleasure or contempt.

They should also have good foundations to prevent their being raised out of place by frost.

DOORS.

It is a common practice to set the jambs for doors for the plasterer to finish to. This is an injury to the jamb in many ways. It is subjected to wetting by the mortar and gets sprung all out of shape by it, and also by the settlement of the building to its place by the accumulating weights. It is the proper thing to put up rough grounds for the plasterers to work to. Jambs should then be perfectly squared and set plumb. Doors should be of the best material and qualities; a poor door is a bad investment at any price. They should be well fitted and hung on loose-joint butts, so that they can be readily taken off, to ease the fitting when necessity requires; and when it becomes necessary it is always well for an owner to look and remedy the cause before cutting a door. It is also convenient to remove them when opening the whole house for company.

Doors vary in thickness and proportion to the height of stories, also with the use; the height is usually two-thirds the height of the room and the width two-fifths of the height. All doors opening into large rooms and between rooms should be double-faced; the rest may be single-faced—that is, finished or molded on one or both sides. Doors should all have molded saddles of hard wood under them, and turned door-stops with rubber heads to protect the walls. When carpets are run through door-ways saddles may be left out.

The placing of doors should be well considered. Those opening into adjoining rooms should be as nearly opposite as possible.

Doors opening into a room should be hung so that the light will fall directly upon the person entering, that he may be distinguished quickly. They should also open against the fire-places, so as to prevent a suction of heat from the fire-places up the hallways.

Doors opening into chambers should be placed so as to conceal the bed from view of persons in the halls, securing all the privacy possible.

Doors which are liable to clash should be hung with their backs near together, then they are not so liable to strike.

WINDOWS.

Windows should have strong frames, made in the best manner, with casings and boxes for weights if for a frame house; hanging stiles and back linings if for a brick house.

Pulley stiles are best made of southern pine, fitted with pulleys of sufficient sizes.

Sash should be of good thickness, made and fitted to prevent rattling, and balanced with true weights, hung on hemp or Silver Lake cord. If they run hard a little tallow or soap put in the race-way usually cures the trouble. Sash are hung in other ways without weights, but the inconvenience overbalances the little difference in cost.

Windows slightly recessed, and clustered in groups, add an inviting charm to rooms, and suggest enjoyable nooks which make homes more attractive.

Casement sash are used in large extended windows or for opening on balconies, and special appliances for rendering them tight against rain and snow-drift must be used with them.

Transom windows give added grace and afford means of ventilation. They can be elegantly filled with stained glass in ornamental designs.

The general proportion of windows vary in height from twice to three times their width, and other windows of all proportions, from the dungeon light to the lanterne, used with discrimination, give air and light in darkened recesses, and are left plain or decorated as the taste in the style adopted seems to warrant.

GLASS.

Glass is divided into three general grades of thickness, single thick sheet, double thick, and plate. All to be good should be free from stains, flaws and burns, which are easily discovered by use of a black cloth. All winding or imperfect glass should be rejected, as it is a blemish to any house.

Stained or decorated glass has of late been so materially cheapened as to be afforded by almost every one. Special tints are fashionable and the most expensive; finely toned tints, subdued in color, give the most pleasing effects. Bright flashing colors should be avoided, as injurious and affecting many persons unpleasantly.

Hammered glass softens effects of the colors.

Unlimited expense can be added if desired, but that should be no hindrance to persons of limited means gratifying their taste if they desire to, for with a moderate outlay they can obtain very pleasing results.

PLUMBING.

We have now reached a subject of vital importance, which affects the health, comfort, and pocket of the owner *either for better or for worse.* The plan of the house should be arranged so as to give the best accommodations for all arrangements from the kitchen to the bath-room, and also to secure the arrangement of piping in the interior walls. There are numerous considerations which must affect the arrangement of plumbing, both

for effective service and in sanitation, which are imperative, and unless carefully looked after and conscientiously performed, health in mind and body is seriously affected.

Owners are usually struck with a peculiar streak of economy when plumbing is to be done, which is so decidedly against their best interests that we must caution them that no investment in a house pays better interest on the money expended than wise and judicious plumbing.

All materials used in plumbing are expensive, but not more so than other goods, when the labor of manufacture is considered. The quality of materials must always be the best, the manufactures from reliable firms, and the plumber engaged an experienced and competent workman, worthy of high wages if he will do his work properly.

Plumbing to be properly put in must commence with supplies of sufficient capacity to ensure service. Hot and cold water pipes not put side by side, as is sometimes done to prevent freezing, but the cold water pipes properly covered and protected from freezing, and arrangements for emptying them when freezing is feared. They should not be bricked or plastered tight in walls, but boxed in, with covers that can be easily removed. Hot water pipes should be provided with circulators, so that delays and waste are not caused by waiting for hot water to arrive.

Soil and waste-pipes must be carefully trapped with approved traps, and connected by ventilating pipes up through the building, and out of the roof. Provision must be made to prevent syphonage of traps, and all wastes caulked tight, and properly connected with sewer. Arrangements must also be made to prevent choking by grease, washings of ashes, etc., which many persons persist in sending through wastes, and as they cannot be individually prevented, special safeguards must be provided.

Numerous and minute details would be necessary to complete these hints if we were to attempt to explain plumbing in its parts, and the special arrangements for proper observance of the laws of sanitation, but we can only say, be cautious to get the best possible treatment of your plumbing by professional men, and if you succeed in getting a perfect job let the amount of the bill be considered but a cheap price for work well and faithfully performed.

PAINTING.

The principal material used in house-painting is either white lead or oxide of zinc, ground in raw (unboiled) linseed oil, in proportion of three or four pints to each ten pounds.

Good painting in lead requires four or five coats, but usually three is given, leaving the additional coats to a future period. Each coat must be

allowed to dry perfectly before applying the next, and put on quite thin if durable work is desired. One pound of keg paint will cover about two square yards the first coat, three square yards the second coat, and four for the third and other coats.

When, as is usual, raw oils are used for thinning, *dryers* of sugar of lead, sulphate of zinc, or litharge are used, about a heaping teaspoonful to ten pounds of paint. Japan varnish is sometimes added, but is not good, as it causes the paint to crack all over, or *craze*. No dryer is necessary if painters' boiled oil is used for thinning—not that boiled oil dries quicker, but painters' oil comes already prepared with litharge.

Raw oil is clearer in color, lighter, and makes a good surface to paint on. Boiled oils are preferred for interior work.

Turpentine is used also for thinning paint, and makes it flow very freely, but as it destroys the gloss of oil it is called *flatting*. Little or no turpentine should be used in work to be exposed to the weather, and on inside work only when a *dead finish* is wanted, or haste in finish is required. While turpentine is not a dryer, it evaporates quickly, and facilitates hardening.

White lead paint is adulterated extensively with whiting, and if adulterated it should not be used, if good work is required. White lead, while it is the most used, is also the most perishable paint we have in use, and discolors easily. *Mineral* paints, with chemical combinations, are in common use under various names, and are cheaper, very serviceable, and stand weather very well, but should be well tested before use.

Colors are *mineral*, *vegetable*, or *metallic*; that is, are oxides of metals, etc., more or less durable, and are ground in oil for house-painting, ready for mixing.

All surfaces to be painted should be well smoothed with fine sand-paper, all dust removed, and perfectly dry. Nail-heads should be punched one-eighth of an inch below surface, and puttied up on the second coat; not on the first, as the wood absorbs the oil, and the putty will not stick. *Knots* should be covered with a couple of coats of shellac, dissolved in alcohol, and then smoothed off with sand-paper. No turpentine should be used in the first coat, as the wood absorbs it quickly and leaves the paint on the surface without cohesion.

The best paints for preserving iron are made of pulverized oxides of iron. Painting unseasoned wood hastens its decay.

FILLING AND VARNISHING.

When it is desirable to retain the surface and effects of natural woods, they are smoothed perfectly and a coat of filling applied, which fills up

the pores of the wood, enhances the beauty of the natural marking of grain, and presents a very smooth finish for varnish. Filling, if colored a little, heightens the effect, and gives an appearance of age—often desired. It is sometimes colored to produce imitations of darker woods.

Varnish should be of good quality, and well applied. It can be worked so as to give a *dead* or *glossy* finish, just as desired.

Wood-work prepared for filling and varnishing should be secured in place by secret nailing as much as possible, and by brads prepared for the purpose; when necessary to use putty, it should be colored to match the wood. Sound knots in the wood-work are sometimes desirable for effect of finish.

Ebonizing and *color-marking* is usually done with fine colors ground in japan; they dry a dead color, and the bright effect is given by the varnish.

VENTILATION AND WARMING..

Thanks to a few persevering sanitarians, attention has been aroused to the attendant evils of poor ventilation. Some people feel quite assured that all ventilating methods are failures, while we find in experience that they all have some points of value, but the use of them is so little understood that they become useless.

Ventilation implies use of proper warming apparatus, and fuel; and to *use* it with discrimination is the true source of economy, not its *disuse.* Writers often elaborate on all the distinct proportions of good and bad air, but with the majority it is of no moment.

We feel as though we could not too strongly urge upon those preparing plans for new buildings, the vital importance of full and ample provisions for ventilation and warming. Proper flues for heating, and foul-air pipes are a necessity, even in cellar-walls, so it is proper to provide for them in planning, for they cannot be provided for afterwards without great cost and trouble.

It does seem as though it was time we had learned to build our houses to enjoy them after spending so much upon them, and we should have in just as pure air as can be obtained out of doors. Costly appliances are not necessary, but *motion of air* is necessary, that true comfort may be attainable.

Arrangements for ventilation cost but little, when provided for. Open grates for ventilation are good, and their woful waste of heat and fuel is an item every one notices; but as better health is a consequence, it is wise to continue them where you can have nothing better. Our essay, however, is to those about building, and to them we can earnestly say: Pro-

vide liberally for ventilation and warming; study up the subject and apply its principles, and if it doesn't work, it will be because it is out of order somewhere.

An illy ventilated room is colder than one well ventilated, as it is the nature of foul air to neutralize the effect of heat on the body, and when one suffers from cold extremities in a warm room it is the sure sign of imperfect ventilation.

We caution owners from hasty selection of heating apparatus recommended only by the manufacturers, but to be wise and prove a furnace before it is ordered.

Heating by steam has numerous advantages to health and comfort which recommmend it, and we hope to see it in more general use.

Our remarks may seem to be intended only for expensive houses for wealthy people. While they are indeed addressed to them as well as to those in moderate circumstances, still ventilating appliances are readily adjusted to the cheapest house ever built, and the expense is only in proportion to the cost of the house, and small at that.

FURNACES AND PIPES.

Set furnaces are enclosed usually in a room formed of brick, with doors set in for coal, ash-pans, air-boxes, and a man-hole; the top covered with sheet-iron or tin set on ribs of iron and soldered. It is always well to set them down in a pit, bricked around, and the bottom grouted solid in cement mortar. They should be at least one foot below the bottom of the joists.

The *pipes* should all be well formed, set in place, and hung with stout wire fastenings to iron hooks; and where they approach nearer than a foot to the wood-work the joist should be flashed with tin. All pipes should have dampers in them down near the furnace, to prevent the heat accumulating in pipes not in use. Those extending up through partitions to upper stories should be double, and the space not less than one-half inch all around filled with plaster of Paris.

Wire lathing should be used for the plaster to render to. Where single ones are used all the studding and ends of joists on partitions near them should be flashed with tin, but even then they are unsafe.

Whenever possible it is best to use the chimneys for carrying the pipes.

Registers are in variety, for the floor or side walls. Those with soapstone borders and double boxes are the best for floors, and extra boxes of tin should be placed around the registers in side walls, all set in plaster of Paris.

FIRE-PROOF BUILDINGS.

Buildings indestructible by fire have never yet been built, as all material is influenced by heat to its destruction, but that we may add preventatives and obstacles to its progress is possible and necessary in all kinds of buildings; even frame houses can be made comparatively fire-proof against the usual causes of fire, and neglect of proper precautions against draughts of air in buildings of iron, stone, or brick will render their destruction sure from very trivial causes.

The first preventative of fire is to effectually close up all systems of air-chambers in walls, floors, and roofs, and check all possible continuations of draft from the lower part upward and through the roof. This may be considered by some to mean also a checking of ventilation, but it is not so, for ventilation, to be proper, should be regulated by flues of its own, constructed for that purpose. Plaster is a most effectual stopper to close up the openings referred to, though sometimes a few bricks will be needed to help fill in the openings to the spaces.

Heating pipes should be put so as to clear all wood-work, and as before recommended, put in double and plastered between, and timbers flashed with sheets of tin. Wood-work is also easily protected by a coat of plaster mixed with ashes.

Hearths should not be set on wood bottoms, but on brick arches, and in sand.

Outside brick walls and party-walls should all be extended above the roof at least one foot, and coped with blue-stone to prevent flames from adjoining buildings affecting the roofs. It is also necessary to see that all outside cornices, cappings, and appendages are not simply traps inviting sparks to set them on fire.

When constructing a building it is poor policy to neglect these few common precautions for the sake of their slight cost. The full amount of insurance cannot pay for valuables, whether costly or not, and the long illness from colds and nervous prostration of the inmates is an item of magnitude for which money cannot pay. So it should be with us a considered necessity that all parts of a building are finished with the best precautions possible against fire, and as even our best efforts may not be sufficient against it, means of escape are of equal importance. Inside stairways and means of egress are better than exterior ones, and devices of all kinds for putting out fires should be familiar household appendages.

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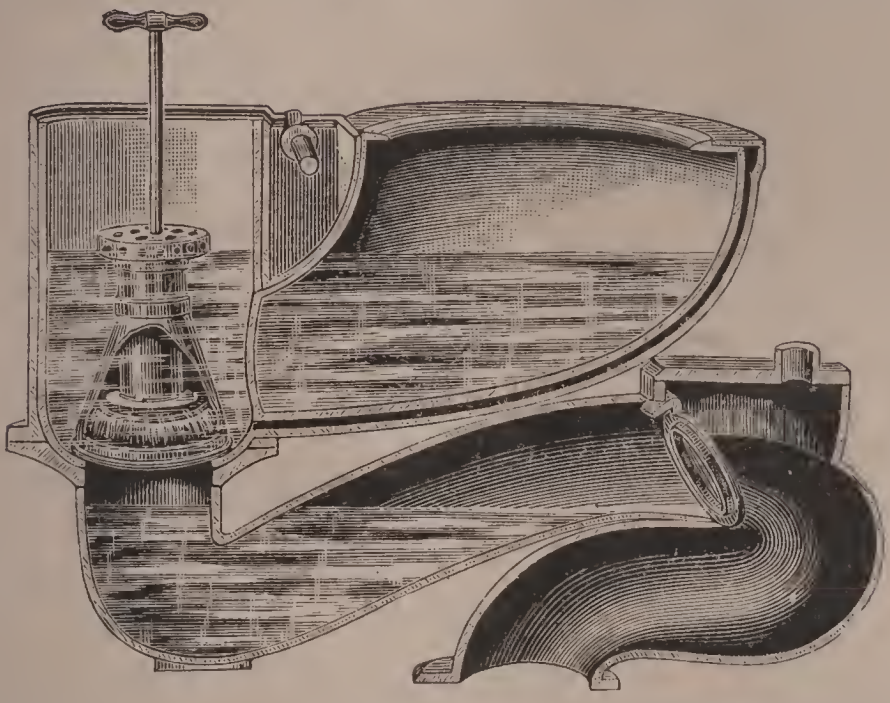

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